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BEANS.

BY

L. C. CORBETT,

Horticulturist, in Charge of the Arlington Experimental Farm, Bureau of Plant Industry.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., March 15, 1907.

SIR: I have the honor to transmit herewith and to recommend for publication as a Farmers' Bulletin a manuscript entitled "Beans," prepared by Prof. L. C. Corbett, Horticulturist, in charge of the Arlington Experimental Farm.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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BEANS.

INTRODUCTION.

The bean belongs to one of the most important families of economic plants with which man has to deal. While there is a great variety of plants belonging to the pulse family, of which the bean is a member, varying in size from low annual plants to tall, broad, spreading trees, there are few members of this group which possess greater economic importance than does the bean. Besides furnishing wholesome, nourishing food for man and for animals, this group of plants provides the agriculturist with a means of securing from the great store of nitrogen in the air, by the use of one of its members in the crop rotation of his farm, a sufficient quantity of nitrogen to replenish that taken from the soil by other agricultural crops. Not all leguminous plants provide food for both man and beast and at the same time increase the fertility of the soil upon which they grow. The bean, however, is one of those which has this capability. It is therefore one of the most desirable crops to use in the farm rotation, as well as in market-garden work.

While the value of beans and peas of various kinds as food for man and stock has been known for many generations, it is within the memory of men now living that the value of these crops as soil renovators and fertility restorers has been definitely proved. Since these facts have become known the value of such crops is being more and more appreciated, and their cultivation, as a result, very greatly extended.

Perhaps no single agricultural crop is of greater economic importance to the people of the United States than cowpeas, yet its cultivation is comparatively recent in this country. Each year the crop is better appreciated, and its area is being rapidly extended. While the cowpea is not a true bean it is a valuable forage crop and a great soil renovator. The seeds are valuable as grain, the hay is equaled only by alfalfa, and as a producer of organic matter for green manuring it is unsurpassed.

The member of this great family with which we have at this time to deal—the bean—is not so valuable from the standpoint of forage or soil renovation, but is among the most valuable members of the great group for the seed which it produces. While the seed is the most important and valuable factor, the power to gather nitrogen and to render the soil better for having been grown upon it is an important consideration and one which should not be overlooked by those interested in maintaining the nitrogen content of the soil.

TYPES OF BEANS.

Under the general term "bean" there are no less than eight distinct species of plants, native to nearly as many distinct sections of the surface of the earth. These eight closely allied plants, descriptions of which follow, are quite universally spoken of as beans, and are deserving of mention in this connection, although not all of them are treated as are the common beans, which is the primary subject of this bulletin.

Broad beans.—The Broad bean (*Vicia faba*) is one of the oldest members of the group of leguminous plants so far as the records of profane history hold information concerning such plants. It is, however, of minor importance within the confines of the United States, although it is a valuable garden as well as agricultural crop in Canada and most European countries. Upon the continent of North America its cultivation is chiefly confined to the Dominion of Canada, where it is grown as a garden crop and as a companion to corn for silage purposes. This plant requires a long, cool summer, and because of the intense heat and protracted periods of drought characteristic of most quarters of the United States, it does not thrive in this country.

Kidney, or Haricot, beans.—Kidney beans, known also as Haricot beans, and technically as *Phaseolus vulgaris*, are the common field and garden beans of America. They also enjoy the distinction, so far as records carry evidence upon this point, of being native to the New World. It is the cultivation and uses of this class which are to claim our attention in the present publication.

Lima, or Sugar, beans.—The plants of Lima, or Sugar, beans (*Phaseolus lunatus*) are normally rank-growing climbers, although within recent times a dwarf, nonclimbing variety has been developed. They thrive best on strong, well-enriched lands and under tropical or subtropical conditions.

Dolichos beans.—Two familiar examples of the Dolichos group of beans, which differ slightly from the common beans, are known as the Hyacinth bean and the Asparagus, or French Yard-Long, bean.

Soy beans.—The soy, or soja, bean (*Glycine hispida*), while for generations known and much appreciated in Japan, is a comparatively recent introduction into the United States, and its cultivation has not as yet become general. In Japan it is a valuable food for man as well as for stock, but in the United States it has received little attention for purposes other than the production of forage for cattle and swine. It is destined, however, to become a very important agricultural product in many sections of the United States, both as a grain and forage crop.

Scarlet Runner beans.—The Scarlet Runner bean (*Phaseolus multiflorus*) is a strong-growing climbing plant, used for decorative purposes on account of its clusters of bright blossoms and the high color of the matured pods, which give it an ornamental value of no mean significance.

Velvet, or Banana, beans.—The Velvet, or Banana, bean (*Mucuna utilis*) is one of the most exacting members of the bean family as regards temperature, and as a result in the United States it can only be grown successfully within comparatively narrow limits. In Florida and along the Gulf coast it has in recent years become an important forage as well as green-manuring crop. In those sections of the United States where it can be successfully grown it is a worthy competitor of the cowpea and soy bean.

Cowpeas.—The cowpea (*Vigna sinensis*), because of its bean-like seed and habit of growth, its great economic importance as a forage crop for the production of hay and silage, and its great value as a green manure, should be mentioned in connection with the other plants to which it is so closely related both botanically and economically.

FIELD AND GARDEN GROUPS.

For convenience in reference and for discussion, beans may be divided into two general groups—"field" and "garden" beans—which are by no means distinctly separate either in appearance or in characteristics. Each of these groups can again be divided into bush and pole beans. Bush beans of the field type are recognized, for commercial purposes, under three well-marked types, known as Kidney, Marrow, and Pea beans, each of which may be subdivided into two groups, colored and white. The garden beans, like the field beans, may be divided into bush and pole types; these again into Kidneys and Limas, the term "Kidney" in this case including all of the common

garden beans whether of one type or another, and this group may again be divided into wax and green pod. The same subdivision may also be recorded under pole beans, as is suggested in the following classification:

Classification of beans according to groups and types.

- Field beans
  - Bush
    - Kidney
      - Colored.
      - White.
    - Marrow
      - Colored.
      - White.
    - Pea
      - Colored.
      - White.
  - Pole or corn hill ... White or colored.
- Garden beans
  - Bush
    - Kidney
      - Wax.
      - Green pod.
    - Lima.
  - Pole
    - Kidney
      - Wax.
      - Green pod.
    - Lima.
    - Runner (Scarlet Runner).

ACREAGE GROWN.

There are no statistics available from which to determine the acreage or quantity of beans produced as field beans and as string and garden beans. The census for 1900 gives the area of the bean crop, including both field and garden beans, as 453,867 acres, and the total product is placed at 5,064,844 bushels, an average of 11⅛ bushels per acre. The total amount received by the producers for the crop was $7,634,262, or an average of $1.51 per bushel. In considering this average it must be remembered that the total includes the products of good as well as of poor cultivators and embraces regions in which the crop was a practical failure as well as those in which it was a success. For those States which make bean growing an important industry the average yield to the acre is somewhat higher than is recorded in this general average.

The three States which lead all others in the production of this crop are Michigan, New York, and California, followed by Wisconsin, Maine, Virginia, North Carolina, Tennessee, Missouri, Minnesota, Illinois, Kentucky, New Mexico, and West Virginia. The other States which produce a considerable acreage of garden beans, with the exception of Florida, cultivate less than 3,000 acres. Florida is reported as cultivating 9,189 acres in 1899. The great bulk of this crop reached the market as snap or string beans. Those beans which were not marketed in this way were of course allowed to ripen and represent a small percentage of the total crop of dry beans. The States in which the great bulk of dry or field beans is produced are Michigan, New York, California, and Maine.

The geographical distribution of this crop, as indicated by the census of 1900, is clearly presented in the accompanying map (fig. 1), which shows the counties in the several States where dry beans are grown commercially. This map shows the influence of climate in determining the regions to which this crop is adapted. The high latitude and the peculiar soil conditions of the New England States and of New York and the high latitude of Michigan, Wisconsin, and Minnesota are equally suited for the production of this crop. Another region where there is considerable interest in the culture of this crop is along the Allegheny Mountains from southern Pennsylvania to northern Georgia. In the north-central part of California, in high altitudes, are also important bean-producing centers.

Within the last decade the cultivation of field beans has increased

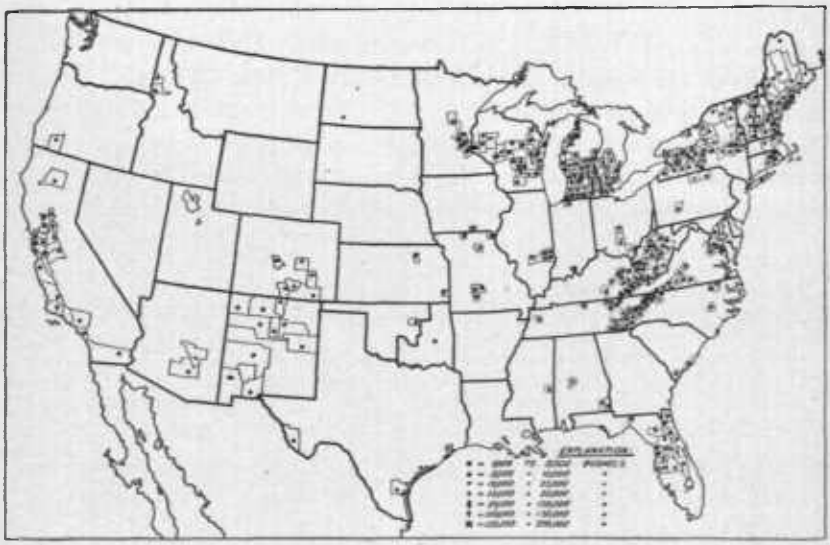

FIG. 1.—Map of the United States showing counties in which dry beans are commercially grown.

markedly in certain sections of the eastern United States, particularly throughout New York and Michigan. In many areas in these two States beans have become as much a staple crop as was wheat a quarter of a century ago. From an economic standpoint this is a valuable addition to the farm rotation of the region because of the ability of this crop to improve the land upon which it is grown. If for no other reason than this, the bean crop taking the place of wheat in the rotation would be an advantage to the community. Of late years, however, the bean crop has been a more remunerative crop than wheat, which adds a pecuniary reason for growing the crop to the soil-improving value previously noted.

While the distribution of field beans is to a very considerable extent determined by soil and climate, the production of garden beans is not

so emphatically influenced by these factors. The quick growth of garden beans enables the truck farmer and the market gardener to take advantage of that portion of the year when the climate of the region is most congenial to the production of the crop, and for this reason the demands of the market as well as the location of the grower determine largely the area of garden beans to be grown in any particular locality. Shipping facilities, of course, have as marked an influence upon the distribution of garden beans for early market as upon any other truck crop.

A third rôle in which beans play an important part is that of a product for the canning factory. The production of fresh beans for canning purposes conforms more closely to the area in which field beans are produced than to that where garden beans are grown for early market.

From what has been said, it is evident that there are two important divisions of the bean industry in the United States, namely, the production of field or dry beans and the production of garden beans. The latter involves two industries: (1) The growing of beans for early market, and (2) the raising of string or snap beans for use by the canning factories.

FIELD BEANS.

Reference to the map (fig. 1) giving the distribution of the areas in which beans are commercially cultivated shows that the regions in which the cultivation of this crop is most intensive lie chiefly within the areas covered by the glacial drift of the great ice age. The soils of the area are as a rule strong and retentive, carrying large quantities of lime and considerable potash, phosphoric acid, and organic materials. It is not strange, therefore, that a crop which is able to gather nitrogen from the air should thrive well upon soils having an abundant store of phosphoric acid and potash.

While beans produce abundantly upon strong clay soils, yet the clay loams, shales, and gravelly soils of the drift region are better adapted to the production of this crop than are the heavy clays. The growth of vine is too much restricted upon the very heavy clay soils, and while in proportion to its growth the vines yield well, the total product is in proportion to the growth of the plant as a whole. Figure 2 shows a typical bean field in the North.

PREPARATION OF THE SOIL.

Since the bean is a warm-season crop and can not safely be planted until after danger from killing frost has passed, the preparation of the soil for field beans should be deferred until the vegetation covering the area has made considerable growth, so that it may be as completely destroyed as possible during the operations of plowing,

harrowing, and fitting the land for the reception of the seed. The short-season character of the bean crop enables the land to be occupied during the winter months by some cover crop, such as wheat or rye, and if the same land is used year after year for the production of beans, the turning under of winter cover crops furnishes an important means by which the store of organic matter in the soil can be maintained, a consideration of great moment in sections chiefly dependent upon commercial fertilizers as a source for available plant food.

After the land has attained proper dryness in the spring it should be plowed from 6 to 8 inches in depth, and immediately compacted and harrowed, so as to prevent the loss of moisture. The surface of

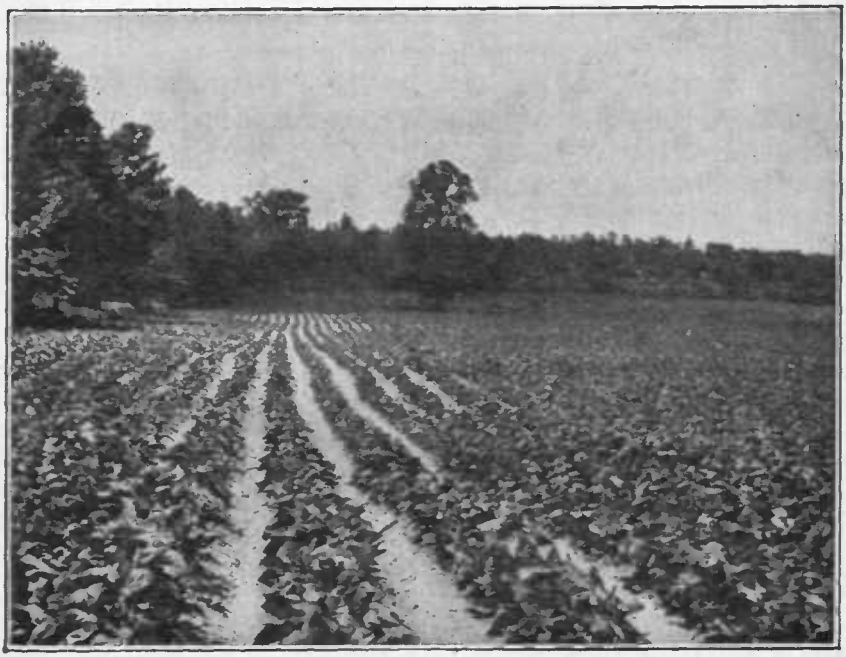

FIG. 2.—A typical bean field in the North.

the seed bed should be made smooth and fine, so that the drill or planter can be economically used upon it. If dry weather follows at this season of the year, a good practice is, immediately preceding the planting of the crop, to run a heavy land roller over the area, particularly if the planting is done with an ordinary grain drill. If the planting is done with a planter similar to the ordinary corn planter and the land has been rolled previously, it is advisable to go over it with a spike-tooth harrow or some other type of smoothing harrow after the crop has been planted, in order that the land may not possess a compacted condition from the substratum to the surface.

The surface mulch which is produced by the use of the smoothing harrow after rolling and planting leaves the soil in the most desirable condition.

PLANTING.

It has already been suggested that field beans should not be planted until all danger from injury by frost has passed. In fact, growers have found that it is better to postpone planting the crop until as late in the season as is practicable and yet be able to safely harvest the crop before the vines are injured by fall frost. The late planted crop has the advantage of escaping the most serious attacks of the bean rust. While there are undoubtedly varieties which are more or less resistant to this trouble, yet the general practice of late planting has been found to be of decided advantage.

In planting the field crop the distance between the rows varies from 28 to 36 inches, according to the implements used in harvesting the crop, 30 inches being a very satisfactory and not an unusual distance for placing the rows. The seeds are so scattered as to fall from 2 to 4 inches apart in the row. The ideal distance would be undoubtedly 6 inches, if it were possible to obtain a perfect stand of plants at this distance. Experiments conducted by the writer and by other investigators have clearly demonstrated that beans planted singly in the row at intervals of from 4 to 6 inches apart produce a much more abundant crop than the same quantity of seed planted in hills from 18 inches to 3 feet apart. For distributing the seed in the row at these distances a bean planter or a check row corn planter may be set to drop the seeds in drills. A common practice is to use an ordinary grain drill and stop a sufficient number of tubes to enable two or three rows of beans to be planted at the proper distance apart without the necessity of purchasing a special implement. By the use of range poles and a 9-tooth drill spaced 8 inches, three rows of beans can be planted each time the field is crossed, leaving the rows 32 inches apart. An 11-tooth drill can be arranged to plant three rows of beans 32 inches apart, if the teeth of the drill are spaced 8 inches, by driving the wheel in the preceding wheel mark on each return trip.

Those contemplating the purchase of implements for different uses should carefully study the adaptability of the implements to the work desired. It will readily be seen that an 11-tooth drill arranged to plant three rows 32 inches apart will be a much more convenient implement than a 9-tooth drill similarly spaced, as the larger implement does away with the necessity for using range poles.

Quantity of seed necessary.—The quantity of seed required to plant an acre of beans varies with the size of the beans; that is, a half-bushel of small Pea beans is sufficient to plant an acre of ground,

while a bushel of Red Kidney beans is hardly sufficient to plant an acre when the seed is distributed in the ordinary fashion in drills rather than in hills. In planting beans of the Pea and Marrow types the quantity of seed varies from one-half to a bushel per acre, depending upon the quality of the beans and upon the preferences of the planter. For Kidney beans the quantity varies from a bushel to as much as six pecks per acre. Ordinarily, with rows 30 inches apart, a bushel is a sufficient quantity for seeding an acre.

Depth of planting.—The depth at which beans should be planted is determined by the character of the soil and the season of the year at which they are planted. In heavy, retentive soils planting should be made comparatively shallow, as the peculiar habit of growth of the bean is such that it can not readily reach the surface if planted deep in such soils. Upon light soils and early in the season planting can be made quite deep. Three inches is not too deep upon such soils, but an inch and a half or 2 inches is the maximum depth for planting upon retentive soils. The cowpea is possibly more exacting in regard to the depth of planting than the field bean, the stalk of the young cowpea being more slender and less able to force the seed leaves through any crust of earth that may have formed after planting. All things considered, a satisfactory depth for planting beans is about 1½ inches.

CULTIVATION.

Like all other hoe crops field beans require frequent, shallow cultivation. The stirring of the soil for the purpose of holding the weeds in check and preserving a soil mulch over the area occupied by the growing crop is the important factor to be considered in culture. Implements with narrow blades which stir the soil to a depth of between 2 and 3 inches are most desirable. Those designed for the culture of corn, which are provided with narrow blades such as accompany all implements provided with spring teeth attachments, will be found satisfactory for the cultivation of beans.

At the last cultivation the plants may be slightly hilled; that is, the soil may be thrown toward the plants with small wings. This has the advantage of leaving the plants on a slight ridge, which facilitates the work of harvesting when such work is done by mechanical means. In the cultivation of beans it is traditional that they should not be cultivated when the dew is on the vines. This undoubtedly has a slight foundation for the reason that moisture is a conveyor of spores of disease and might have a tendency to distribute them more widely than would be the case if moisture were allowed to dry off the leaves without being disturbed.

HARVESTING.

For many years the handling of hoe crops, such as field beans, upon an extensive scale was impossible because of the great amount of hand labor necessary to gather the crop. Within recent years, however, labor-saving devices have been invented so that now the once laborious practice of hand-pulling individual plants can be done away with by the use of a bean harvester.

This implement is built on the principle of a pair of shears and consists of two long steel blades mounted upon a strong framework carried upon wheels, as illustrated in figure 3. The long shear-like blades are set to cut the roots of the plants just beneath the surface of the ground. Above these blades guard rods or guide rods are so arranged as to move from their original positions the plants whose roots have been severed, and, since the implement is designed to cut two rows of beans across the field, the plants of two rows are thrown together in a single windrow. This clears a space for the passage of one of the animals in the team, so that it is necessary for only one to pass through the standing crop, thus decreasing the amount of loss by shelling which would result from both animals being driven through the standing crop.

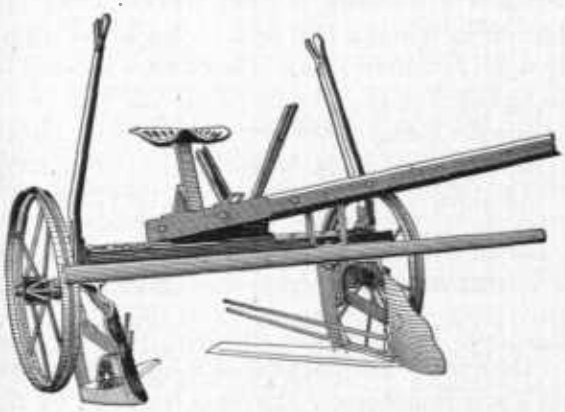

FIG. 3.—A bean harvester.

After the plants are thrown together by the harvester, as shown in figure 4, it is customary for men with ordinary pitchforks, either 2 or 3 tined, to follow the harvester and place the beans in small heaps, as shown in figure 5, to cure for several days before storing them in barns or sheds for thrashing. In some instances, where the work is done upon a very extensive scale and where the loss from shelling is not considered sufficient to justify the employment of hand labor for bunching the beans with forks, an ordinary horserake is employed for the purpose (see fig. 6).

Where the beans are to remain for a longer period and to become more thoroughly cured in the field and where the work of harvesting is done entirely by hand, the crop is frequently placed in shocks which are built about a pole 4 or 5 feet in height, both ends of which

have been sharpened and one end firmly placed in the ground. A small quantity of straw, grass, or other material is placed around the base of the stake, and the beans as they are pulled are piled around the pole until a compact miniature stack about 4 or 5 feet high is formed, as shown in figure 7. This operation is very similar to the common practice followed by the growers of peanuts in stacking and curing this crop. The curing process in any case is carried far enough to prevent the vines molding after storing them in the barn prior to thrashing. If the vines are thoroughly ripened in the field before harvesting, they can be stored in from two to three days if the weather is satisfactory. If, however, the vines have some green

FIG. 4.—A bean harvester at work.

leaves upon them and the pods are not thoroughly dry, the period for curing in the field is of necessity much longer than with thoroughly ripened plants.

After the crop has been properly cured in the field it is customary to store the beans in barn lofts or in sheds until the weather has become quite cool before the work of thrashing is done. In some instances, however, if the beans are thoroughly field cured they may be thrashed in the field; but ordinarily, in those regions where beans are extensively grown, weather conditions will not permit of their being cured and left in the field a sufficient period to enable the entire work of harvesting and thrashing to be carried on in the open.

After the plants are thoroughly cured they are carried as carefully as possible to the building in which they are to be stored. In fact, all operations connected with the harvesting and field management of beans should be done as carefully as possible, in order to avoid injury to the plants while in the growing condition and to prevent shelling the beans after they have ripened. Most varieties of beans shell more or less easily after the pods have become thoroughly matured. The loss from shelling will depend largely upon the care in handling them during the various operations of harvesting and storing. Most extensive growers of beans, however, consider the loss by shelling resulting from the use of labor-saving machinery of less money value than the added cost of carrying on all operations by hand in the most careful way. In other words, the loss from the use of labor-saving machinery is not sufficient to justify the return to hand labor in the care and management of the crop.

FIG. 5.—Bunching beans by hand.

THRASHING.

Because of the ease with which the pods of the bean are broken and split and the danger of breaking and splitting the seed of the bean, the operation of thrashing is one of the most exacting connected with the production of dry beans. In olden times beans were thrashed almost exclusively by the use of the flail, and small crops are still handled in this way. On an extensive scale, however, beans are thrashed by machinery specially designed for the work. The ordinary grain thrasher can not be modified so as to satisfactorily do the work, although it is sometimes employed when other specially designed machinery can not be obtained.

The modern bean thrasher, a section of which is shown in figure 8, consists in reality of a double, or tandem, thrashing machine, carrying one cylinder which is operated at a comparatively low rate of speed and a second cylinder run at a much higher speed. The slow cylinder, which is the first, separates the beans from the dry pods.

The vines, with the tougher pods, are then passed on to the second cylinder, which is operated at a much higher rate of speed and is better equipped to separate the beans from the pods which are tough and more retentive. By this arrangement there is less injury to the seed and consequently less loss both from splitting the beans and from passing over beans in tough pods, which would be the result of thrashing with a single cylinder machine operating the cylinder at a low rate of speed.

CLEANING AND GRADING.

While the farm operations in connection with the preparation of field beans for market usually cease with the thrashing of the crop, the cleaning and grading of the product is a very important item

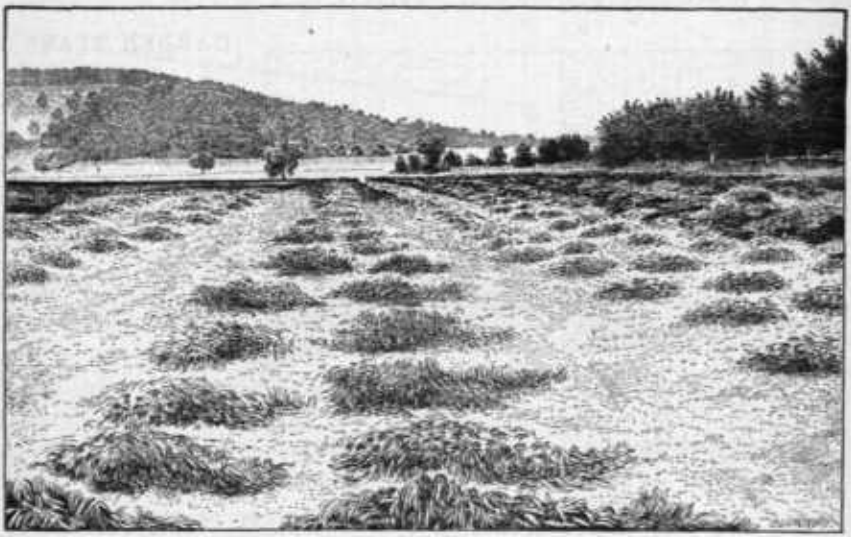

FIG. 6.—Beans bunched with a horserake.

and requires much hand work. Besides the removal of sticks and straws from the grain by the use of the fan, the beans are passed through a machine which is provided with a broad, slow-moving belt placed at such an angle that split beans and peas, dirt, and stones which are not removed by the fan adhere to the belt and are thrown out, while the smooth, perfect seeds fall back into another receptacle and are thus separated from the dirt and broken seeds. After this the beans are usually subjected to a third operation, which consists in removing by hand all broken and discolored seeds, as well as foreign matter, which were not removed in the other operations. The work of hand picking is chiefly carried on by women, and is facilitated by the use of machines operated by the feet or some other

motive power. In large picking establishments these machines are arranged in rows, fed through hoppers, and operated by steam or other power. In smaller establishments and upon farms, similarly constructed machines operated by foot power are employed.

These machines are very simple in construction, consisting of a canvas belt about 6 inches wide passing over rollers, which are operated, as already indicated, either by power or by a foot pedal. The beans which are in the hopper are shaken out upon the canvas belt, and as the belt is carried along the expert picker removes all discolored or broken seeds and foreign matter, dropping them into side receptacles having spouts which carry them into barrels or baskets, from which they can be easily removed. The good beans are allowed to fall over the end of the belt into another hopper and are conducted to a convenient receptacle.

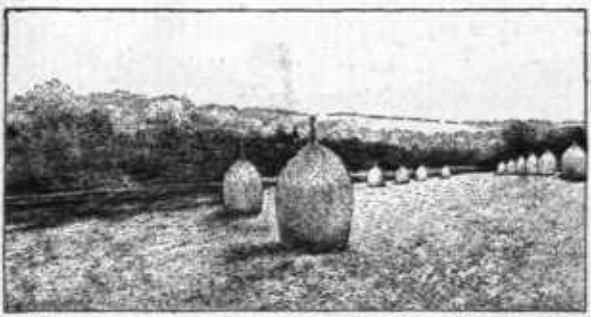

FIG. 7.—Hand-pulled beans stacked to cure.

GARDEN BEANS.

As has been previously pointed out, garden beans naturally fall into two distinct classes, namely, bush and pole beans. Each of these general classes is again subdivided into Kidney and Lima beans. The Kidney beans of the bush type are either wax podded or green podded in character, as are also the pole beans of this class. Lima beans, as is indicated in the classification on page 8, are either of the bush or pole type. Among the garden beans, therefore, there are bush and pole types of the Kidney bean which may be either green or wax podded; and of the Lima beans there are bush and pole types. The character of the so-called Lima beans varies considerably, but chiefly in the character of the seed itself and in the habit of growth of the plant. These differences will be discussed briefly under the topic of Lima beans.

The type as well as the variety of garden bean to be grown is determined by the purpose for which it is to be used. If it is to be used as a snap or string bean for early market, quick-maturing green or wax-podded varieties are selected. If for canning purposes, a different variety is selected, which may have either green or wax pods, while as a rule green beans which are required late in the season

for table use belong to the pole type. For early beans, however, the bush type is the one most commonly used.

It is to be regretted that there are no available statistics giving the acreage, yield, and value of garden beans. The map shown as figure 9 gives the geographical distribution of this industry. The range and extent of the cultivation of this crop are coincident with the business of market gardening and truck growing. Every market gardener, whether he is catering to the demand of a small town or to the requirements of a city market, grows a greater or smaller acreage of beans for use as string or snap beans. It is his purpose to plant the crop so as to secure a succession of pickings from early in the season until the plants are destroyed by frost. With the truck grower, however, the object is quite different. He depends for his profit upon growing a large acreage of a variety which sells well and

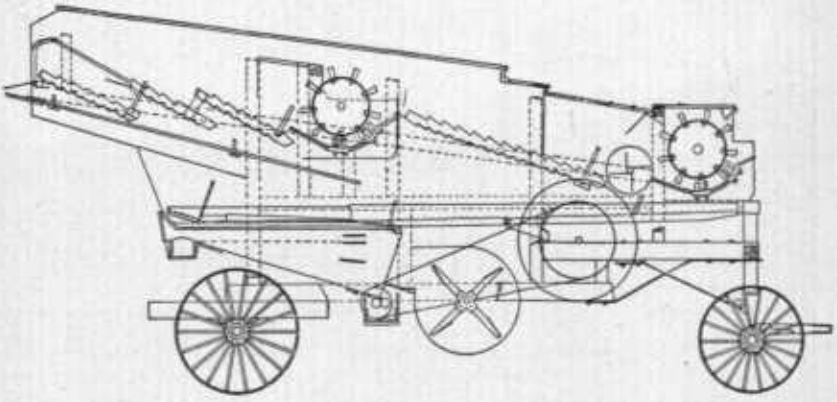

FIG. 8.—A bean thrasher.

which will come to marketable maturity at a time when the products of the particular zone in which he is located have the ascendancy in the market. He does not expect to anticipate this particular period or to reap a benefit after the product of another section located farther north and closer to the market than his own becomes a competitor. In the one case the crop is grown for a continuous supply over a long period; in the other, the aim is to secure a large product of desirable quality for a short time only. Figure 10 shows a typical field of beans as grown at the South for use while green.

A third factor entering into the production of beans of this type is the canning industry. String beans are a staple canning product, and while the canners, located in the cities which are large receiving and distributing points for truck crops, depend to some extent upon the purchase of these products in the open market, yet each of them attempts to have grown in the immediate vicinity of the factory a

considerable acreage of each of the staple products canned by that factory. As a result of this practice, beans are grown to some extent exclusively for canning purposes, but not to the extent that tomatoes, peas, and corn are grown.

SOIL.

Beans adapt themselves to a wide diversity of soils and climate. In fact, garden beans, because they are of rapid growth and reach marketable maturity within a very short time after the seeds have been planted, can be used at certain periods of the year in localities where they can not be successfully grown as a staple field crop for dry beans. Because of this adaptation of the plant, truck growers along the Gulf

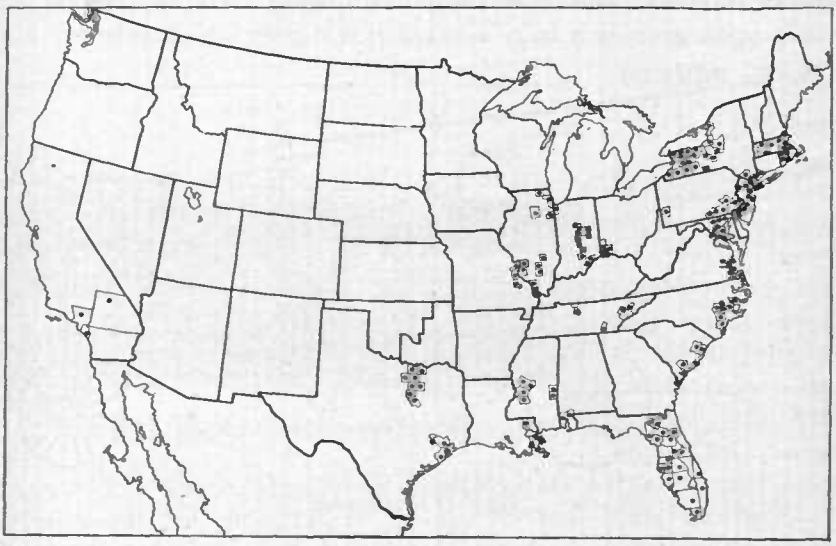

FIG. 9.—Map of the United States showing counties in which string beans are commercially grown.

and Atlantic coasts, from Texas and Florida northward, are enabled to produce a marketable crop of this vegetable by taking advantage of that portion of the season best suited to its growth. The statement just made in regard to the adaptation of this crop to various soils is emphatically brought out by studying the types of soils upon which it is successfully grown from southern Florida to Maine.

The sandy soils of Florida, sandy loams of the Carolinas, Norfolk sandy loam, gravelly loams, and the clay loams of the States north of New Jersey all produce satisfactory crops of garden beans when care in the selection of varieties and in the use of fertilizers is exercised. In general it may be said that climate or season is as great a factor in determining the yield and profit from the cultivation of garden beans as is soil.

Preparation of the soil.—The bean is a hoe crop, and for that reason demands a soil free from obstructions to cultivation—one which is quick and responsive and contains an abundance of available plant food. The preparation should be such as will enable seeds to germinate quickly; that is, so fine that when the seeds are planted the soil shall come closely in contact with the seeds and insure quick germination. Mechanically the soil should be fine, retentive of moisture, and capable of being compacted, yet light enough to permit cultivation immediately after showers and rains, so that heavy crusts will not form and retard the germination and growth of the plant.

For the reception of the seed the soil should be thoroughly plowed and harrowed with an implement which shall fine and at the same

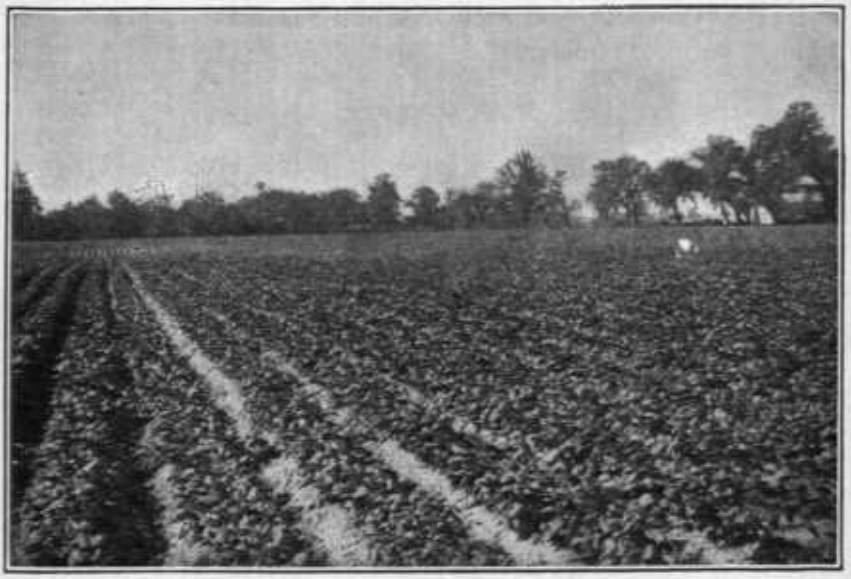

FIG. 10.—A typical field of beans grown in the South for use while green.

time compact it. The depth to which the soil should be cultivated must be determined by experience. It is not wise to plow the land more deeply for beans than for other truck crops. As a general principle, however, soils used fo market garden or truck purposes should be plowed deeply and pulverized thoroughly, so as to maintain a seed bed from 8 to 10 inches in depth.

FERTILIZERS.

While beans are quick-growing and early-maturing plants requiring an abundance of available plant food in the soil, yet, because of their family relations, being legumes, they make the soil better for having been grown upon it. They are nitrogen-gathering plants, and for this

reason require only a small percentage of this element in any fertilizer used upon them. While heavy applications of fertilizers containing nitrogen, phosphoric acid, and potash are used by truck growers in the production of beans, as a rule such fertilizers should be relatively richer in phosphoric acid and potash than in nitrogen. The production of garden beans for snap or string beans, however, demands a larger percentage of immediately available nitrogen than does the production of field beans for the dry grain, as in the former case the crop occupies the land a shorter time and therefore gives it less opportunity to provide itself with a supply of nitrogen from the atmosphere. The fertilizer, if used in the form of commercial fertilizer, may be distributed broadcast over the area occupied by the crop with a grain drill or a fertilizer distributer, or it may be scattered along the row at the time the seeds are sown by one of the many types of seed drill having a fertilizer attachment.

PLANTING.

Garden beans, like field beans, may be planted either in hills or in drills. The customary practice, however, is to plant the seeds in drills so that they shall fall 2 or 4 inches apart in rows far enough apart to admit of cultivation with either one or two horse implements. Because of their peculiar habit of germination—the elongation of the part between the root and the seed leaves, called the hypocotyl—the seed leaves or cotyledons are lifted out of the soil. A large expenditure of energy on the part of the plant is necessary to accomplish this, and the more compacted the soil and the deeper the seed is planted the more time and energy are required in accomplishing this result. It is evident, therefore, that the shallower the beans can be planted without retarding satisfactory germination, the better.

Upon thoroughly fine and compacted soils the seeds are planted from 1½ to 2 inches deep. Shallower planting does not as a rule give as satisfactory germination as planting within the range above mentioned.

While garden beans are planted in extensive areas, as is indicated by figure 9, they are, nevertheless, frequently used as a catch crop between other plants, such as squashes and cucumbers. The bean, being a quick-growing plant, matures its crop and is out of the way before the entire area is demanded by the companion crop. In addition to the value of the crop secured from the beans, it is claimed that they act beneficially as a windbreak to shelter the tender vines of the cucumber during their early life. Beans also serve to increase the income from areas upon which the most intensive types of truck

farming are conducted. Upon such an area, where a fall and a spring crop of lettuce are grown, beans are planted between the lettuce plants just before they reach marketable size, so that about the time the lettuce is removed the area will be occupied by the young beans. It not infrequently happens that the catch crop will defray the expenses of growing the main crop, a matter of great importance in intensive agricultural operations.

Quantity of seed necessary.—The seed required to plant an acre of beans varies with the style of planting, 10 to 12 quarts being required where 3 or 4 seeds are placed together in hills 18 inches apart with the rows 30 inches apart, while 1 bushel to 1½ bushels are needed for scattering the seeds with 2 to 3 inches between them in drills 30 inches apart.

CULTIVATION.

After the beans have appeared above the surface of the ground, the subsequent cultivation should be carried on with implements which stir the surface of the soil only and leave it fine, loose, and almost perfectly smooth. To accomplish this with horsepower implements it is necessary that they have numerous narrow, shallow-working teeth. Cultivators with broad teeth, which tear up the earth to the depth of 4 to 6 inches, leave the ground rough, cloddy, and uneven, thus exposing a large area to the action of the sun and wind, bringing about an undue loss of moisture and indirectly acting to retard the growth of the plant, while shallow cultivation with implements having fine teeth, stirring the soil to the depth of 2½ to 3 inches and leaving the soil fine and loose, has a tendency to conserve moisture by preserving a blanket, or mulch, of loose earth over the compact water-carrying strata, in which the roots of the plants are fixed. This type of cultivation is of decided importance and value in connection with the cultivation of all quick-growing crops which require an abundant supply of moisture for their development.

As the plants become large and heavy, it is advisable at the last cultivation to use winged teeth upon the cultivator in order to throw a small quantity of soil against the stem of the plant to assist in supporting it and for the purpose of covering the root slightly more than it was normally covered by practicing level culture.

HARVESTING.

From the nature of the product the harvesting of garden beans for use as string or snap beans must necessarily be done by hand. Their extensive culture is therefore restricted to areas in which an abundant labor supply which can be commanded at short notice is available. The importance of this is suggested by the extent of the area

shown in figure 10, as well as by the number of laborers shown in figure 11.

The market gardener, depending upon a limited labor supply, in a region where the wage is high, can not afford to cultivate extensive areas of string beans. The trucking district along the Atlantic coast from Georgia northward to Washington is favored by an abundance of colored labor which has, through many years, been trained in this class of work. The ample supply of this labor, while it is not highly efficient, permits the harvesting of the crop at a reasonable compensation, thus allowing extensive areas of string beans to be grown at a satisfactory profit to the planter. It is customary to harvest string beans by the measure, most growers using a bushel basket as the unit for payment.

After the beans are picked they are carried to a convenient sorting table, either in the open or under shelter, where they are looked over,

FIG. 11.—Harvesting snap beans.

all diseased and broken beans rejected, and the baskets uniformly filled and shaken down preparatory to covering them for shipment. The method of assorting beans is shown in figure 12. As is suggested by this illustration, string beans are usually shipped in bushel or half-bushel baskets of the Delaware type. These baskets are made of thin staves, have circular heads and covers, and are usually reenforced with wooden or wire hoops. A ventilated cover is also provided, which is held in place by wire fasteners. After being assorted and packed in these baskets, the beans are transported, if only a short distance, by freight or express without refrigeration; but if shipped long distances they are sometimes placed in refrigerator cars and shipped by freight.

When packed in baskets of this character great care should be exercised to keep the beans from becoming moist, and their storage in cars or rooms where they will heat and take up moisture should be

avoided. Beans are not so liable to injury from heating as peas, but loss sometimes occurs from this cause. In the market beans are usually sold by measure rather than by weight, although the only satisfactory basis upon which to sell any garden vegetable is that of weight.

YIELD.

Under favorable circumstances the best varieties of beans yield very large quantities of pods. It is not unusual to gather 200 bushels of string beans from an acre, the price ranging from $2.50 to 50 cents per half-bushel basket from early in the season until its close for any particular locality.

FIG. 12.—Packing and assorting beans in a truck-garden.

LIMA BEANS.

Under the name of Lima beans two distinct types are now recognized: Pole Limas and dwarf, or bush, Limas. These types are made up from two distinct species, known to botanists as *Phaseolus lunatus*, which includes the Sieva, or Carolina, type of Lima beans, and *Phaseolus lunatus*, variety *macrocarpus*, the true Limas of the American garden, which includes both types of this bean, i. e., the flat, or large-seeded, Lima and the Potato Lima. The pole Lima beans, then, are made up from the Sieva, or Carolina, Limas, the true Limas, the flat, large-seeded Limas, and the Potato Limas.

The dwarf Limas are represented in the Sieva type by Henderson's Dwarf Lima, in the Potato Limas by Kumerle's and Dreer's Dwarf Lima, and in the true Limas by Burpee's Dwarf Lima. It will be seen, therefore, that botanically the pole Lima and the dwarf Lima can not be separated—that varietal differences alone make the distinctions which characterize these two groups.

Lima beans are of very great commercial value, but are not sufficiently appreciated as a table food because it is not generally known that in a dry state they can be used in practically the same manner as are the common beans. In reality they are richer and more delicate in flavor than the common beans, and can be used in as many different ways. The virtues of these types as green beans need only a passing mention, and their value as an accompaniment of corn in succotash is well known to every consumer of canned goods.

Planting.—The common method of handling the Lima bean in the climate of the northern tier of States, outside of the irrigated belt, is to plant from three to five beans in hills 18 to 36 inches apart, with the rows 3½ to 4 feet apart, and after all danger from cold and from insect enemies is past the beans are thinned to about three plants to the hill. As the beans are exceedingly tender, it is necessary to delay planting in the open until about a week or ten days after the time for planting the common garden beans. After the second cultivation, when the tendency to climb has manifested itself, the plantation is supplied with poles from 5 to 6 feet high, or with a trellis running from end to end of the row, which may be made by stretching two or three wires lengthwise of the row and weaving between them strands of ordinary wool twine. If the trellis is employed the beans can be planted in practically continuous rows, so that they stand about a foot apart. Toward the northern limit for cultivating this crop, one is fortunate if one-half to two-thirds of the pods which set upon the plants mature the seed. Farther south the crop is proportionally heavier.

In California and in other irrigated regions where there are well-marked wet and dry seasons, the dry season, accompanied by heavy fogs, occurring during the summer months, it is possible to cultivate Lima beans somewhat as follows: Upon moderately rich, somewhat sandy valley land, cultivation can be carried out by planting the beans as soon as all danger from rains has ceased and the plantation will remain dry except for irrigation. If there has not been sufficient winter rain to thoroughly moisten the land it should be well watered and allowed to dry to a good cultural condition before planting. Seed can then be planted in hills about 3½ or 4 feet apart each way,

or in drills, the beans scattered about a foot apart in rows 4 feet apart. After the beans have germinated it may be necessary to cultivate them once or twice with a sweep of some type, to destroy any weeds which may have sprung up from the moist ground. All moisture should be withheld and a dust mulch over the surface preserved by running a sweep over the plantation once or twice more, and then the vines should be allowed to take possession of the territory. This obviates the necessity of using poles, and the crop can grow to maturity under these conditions without irrigation, without cultivation, and without poles.

At harvest time a root cutter is passed under the lines of the rows, severing the roots of the plants, and after the plants have dried and become somewhat cured they are thrown into convenient heaps for loading on wagons and are allowed to remain in these heaps until near the approach of the rainy season. Then they are carried to the thrashing floors, where they are beaten out by the tramping of animals or by driving over the heap a device somewhat similar to the ordinary cutaway harrow. Where Lima beans are grown very extensively, power thrashers of large capacity are used for separating the beans from the vines. There is more loss reported from the use of these machines than where the old method of tramping them out is followed, but whether this is sufficient to justify the slower process of shelling can only be determined from actual field tests.

The dwarf Lima beans, because of their habit of growth, are planted and cultivated practically the same as are field beans. They are slightly hardier than pole Limas, and for that reason toward the northern limit of the range of this crop can be planted somewhat earlier in the season than the pole Limas.

Cultivation.—The Lima bean is naturally a long-season crop, and in its native country is practically a perennial plant; hence the necessity, in a region with a limited growing season, for taking advantage of every factor in soil and climate which will tend to shorten the period of growth and hasten maturity. It is possible to lengthen the season by artificial means, when growing the plant on a limited scale, by planting the seeds in berry boxes or on inverted sods in a hotbed or cold frame two or three weeks in advance of the regular planting season. The season in the field can be shortened by withholding nitrogenous fertilizers, which tend to induce late growth; by supplying fertilizers like muriate of potash and acid phosphate, which have a tendency to hasten maturity, and by selecting what is known as a quick soil—one which dries out and warms up early in the spring and which, because it is normally inclined to be dry, has a tendency to shorten the life cycle of the plants growing in it.

DISEASES AND ENEMIES.

One of the factors which is of great moment in determining the range of cultivation of field beans is the bean weevil. This pest is much more destructive to beans grown south of the latitude of New York than in areas north of this region. The high altitudes of California and of the Allegheny Mountain region are exceptions to this general rule. Because of the greater destructiveness of the weevil in southern latitudes, dry beans for seed purposes or for table use are not extensively cultivated. As has been pointed out, this crop is confined chiefly to northern latitudes and to high altitudes. In the production of string beans, where the product is marketed in an immature condition, the weevil does not enter as a factor into the production of the crop.

The bean, like many other of our valuable economic plants, is subject to serious diseases, the most important of which is known as anthracnose. This disease is most severe upon the wax-podded types of garden beans, but few of the bush beans, whether of the wax or green pod type, are entirely free from this trouble. Localities may be comparatively free from it for a number of years, but as bean growing becomes more general and extensively engaged in, the disease becomes more prevalent and increases in severity. Growers of field beans have found that the disease is most destructive to the early planted crop, and to partially overcome the loss from its attacks have resorted to planting the crop as late in the season as possible.

While anthracnose can be controlled to a considerable extent by spraying with Bordeaux mixture, the expense of the operation, including the cost of material and of labor for applying it, is so great as to prohibit its general use in the field cultivation of the crop. In market gardens and in restricted areas, where beans are sold at very remunerative prices, it may be advantageous and profitable to treat plants for this disease. The greatest relief from this trouble, it is believed, will come from the breeding of disease-resistant strains of the desired type of bean.